Claims

[c1] 1.A motion-picture-experts group (MPEG) decoder comprising:

a unified VLD/IQ stage having a variable-length decoder (VLD) and a inverse-quantizer (IQ), that outputs from the inverse-quantizer non-predicted discrete cosine transform (DCT) coefficients, the non-predicted DCT coefficients not adjusted for AC prediction of coefficients, the unified VLD/IQ stage not performing AC prediction of coefficients;

an inverse DCT transformer, receiving DCT coefficients, for performing an inverse discrete cosine transform on the DCT coefficients to generate pixels for a current block;

a mux supplying the DCT coefficients to the inverse DCT transformer, the mux selecting the non-predicted DCT coefficients from the unified VLD/IQ stage when AC prediction is not performed, but selecting predicted DCT coefficients for a first row or a first column in the current block when AC prediction is preformed;

a coefficient store, coupled to receive the DCT coefficients from the mux, for storing DCT coefficients for prior blocks as stored DCT coefficients; and

a post-IQ calculator, receiving the stored DCT coefficients from the coefficient store, and receiving the non-predicted DCT coefficients from the inverse-quantizer in the unified VLD/IQ stage, for generating the predicted DCT coefficients to the mux by performing post-inverse-quantizer AC prediction,

whereby AC prediction is performed on DCT coefficients input to the inverse DCT transformer after the inverse-quantizer.

[c2] 2.The MPEG decoder of claim 1 wherein the unified VLD/IQ stage sends quantized DCT coefficients from the variable-length decoder directly to the inverse-quantizer without outputting the quantized DCT coefficients;

wherein the stored DCT coefficients in the coefficient store are non-quantized DCT coefficients;

whereby the quantized DCT coefficients are not used for AC prediction but the non-quantized DCT coefficients to the inverse DCT transformer are used for AC prediction.

[c3] 3.The MPEG decoder of claim 2 wherein the current block is block N, wherein N is a positive integer;

wherein a prior block is an above block N-L when DCT coefficients for the first row of the current block are AC predicted, wherein L is a number of blocks in a image-row of a video frame;

wherein the prior block is an immediately prior block N-

1 when DCT coefficients for the first column of the current block are AC predicted,
whereby prior blocks for AC prediction are above blocks and immediately prior blocks.

[c4] 4.The MPEG decoder of claim 3 wherein the post-IQ calculator comprises:
a current Q-subtractor that receives the current quantization parameter sent to the inverse-quantizer for the current block and receives the non-predicted DCT coefficients from the inverse-quantizer, for generating current corrected coefficients;
a prior Q-subtractor that receives the stored quantization parameter and the stored DCT coefficients from the coefficient store for a prior block, for generating first prior corrected coefficients;
a divider/multiplier, receiving the first prior corrected coefficients from the prior Q-subtractor, for dividing and multiplying by the current quantization parameter to generate adjusted prior coefficients;
an adder, coupled to the current Q-subtractor, for adding the current corrected coefficients with the adjusted prior coefficients to generate combined coefficients; and
a final combiner, coupled to the adder, for combining the current quantization parameter with the combined

coefficients to generate the predicted DCT coefficients to the mux.

[c5] 5.The MPEG decoder of claim 4 wherein the divider/ multiplier comprises:
an integer divider, receiving the first prior corrected coefficients from the prior Q-subtractor, for dividing by the current quantization parameter to generate second prior corrected coefficients;
a multiplier, receiving the second prior corrected coefficients from the integer divider, for multiplying by the current quantization parameter to generate the adjusted prior coefficients.

[c6] 6.The MPEG decoder of claim 5 wherein the final combiner comprises:
an odd generator, receiving the current quantization parameter, for rounding the current quantization parameter to an odd value to generate an odd quantization parameter; and
a final adder that adds the odd quantization parameter to double the combined coefficients when the combined coefficient is positive, but subtracts the odd quantization parameter from the combined coefficients when the combined coefficient is negative, to generate the predicted DCT coefficients.

[c7] 7.The MPEG decoder of claim 6 wherein the current and prior Q-subtractor each comprise:
an odd generator, receiving a quantization parameter, for rounding the quantization parameter to an odd value to generate an odd quantization parameter;
a subtractor that subtracts the odd quantization parameter from a coefficient when the coefficient is positive, but adds the odd quantization parameter to the coefficient when the coefficient is negative; and
a divider that divides an output of the subtractor by two.

[c8] 8.The MPEG decoder of claim 7 wherein the coefficient store also receives the current quantization parameter, the coefficient store storing quantization parameters for prior blocks and outputting the stored quantization parameter.

[c9] 9.The MPEG decoder of claim 8 further comprising:
a parser receiving a MPEG-encoded bit-stream, for parsing the MEPG-encoded bit-stream for segments to send to the variable-length decoder for decoding into the quantized DCT coefficients for a current block;
wherein the parser extracts an AC prediction flag for the current block from the bit-stream;
wherein the mux selects as the DCT coefficients to the inverse DCT transformer the predicted DCT coefficients for a first row or a first column in the current block when

the AC prediction flag indicates that AC prediction is to is preformed;
the mux selecting the non-predicted DCT coefficients from the unified VLD/IQ stage when the AC prediction flag indicates that AC prediction is not performed.

[c10] 10.The MPEG decoder of claim 2 wherein the current block contains 64 pixels in 8 rows and 8 columns represented by 64 DCT coefficients.

[c11] 11.The MPEG decoder of claim 2 wherein a first coefficient in the first row and in the first column is not AC predicted.

[c12] 12. A computer-implemented method for decoding compressed video comprising:
parsing an encoded bit-stream for an AC prediction flag for a current block;
sending a current portion of the encoded bit-stream for the current block to a unified stage;
in the unified stage, decoding the current portion of the encoded bit-stream with a variable-length decoder to generate quantized discrete cosine transform (DCT) coefficients;
in the unified stage, performing inverse-quantization on the quantized DCT coefficients using a current quantization parameter for the current block to generate unified-

stage output coefficients;
selecting as selected coefficients the unified-stage output coefficients for input to an inverse transformer when the AC prediction flag is false;
generating pixels for the current block from the selected coefficients by performing an inverse discrete cosine transform;
storing the selected coefficients for a first row and for a first column as stored coefficients;
storing the current quantization parameter as a stored quantization parameter;
generating predicted coefficients for the first row or for the first column when the AC prediction flag is true by combining the unified-stage output coefficients, the current quantization parameter, a stored quantization parameter and stored coefficients for a prior block to emulate AC prediction; and
selecting as selected coefficients the predicted coefficients for input to the inverse transformer for the first row or for the first column when the AC prediction flag is true,
whereby AC prediction is performed after inverse-quantization.

[c13] 13.The computer-implemented method of claim 12 wherein the prior block is an immediately prior block to

the current block when the first column is AC predicted; wherein the prior block is prior block immediately above the current block when the first row is AC predicted.

[c14] 14.The computer-implemented method of claim 12 wherein generating predicted coefficients comprises:
generating a current difference from the unified-stage output coefficients and the current quantization parameter;
generating a prior difference from the stored coefficients and the stored quantization parameter;
combining the current difference and the prior difference and multiplying by two to generate a combined difference; and
adjusting the combined difference with the current quantization parameter to generate the predicted coefficients.

[c15] 15.The computer-implemented method of claim 14 wherein generating the current difference for each coefficient comprises:
rounding the current quantization parameter to an odd number to generate an odd current quantization parameter;
subtracting the odd current quantization parameter from a unified-stage coefficient that is one of the unified-stage output coefficients when the unified-stage coeffi-

cient is positive, and adding the unified-stage coefficient to the odd current quantization parameter when the unified-stage coefficient is negative;
wherein generating the prior difference for each coefficient comprises:
rounding the stored quantization parameter to an odd number to generate an odd prior quantization parameter;
subtracting the odd prior quantization parameter from a stored coefficient that is one of the stored coefficients when the stored coefficient is positive, and adding the stored coefficient to the odd prior quantization parameter when the stored coefficient is negative.

[c16] 16.The computer-implemented method of claim 15 wherein generating the prior difference for each coefficient further comprises:
adjusting the prior difference by multiplying and integer-dividing by the current quantization parameter.

[c17] 17.The computer-implemented method of claim 16 wherein adjusting the combined difference with the current quantization parameter to generate the predicted coefficients comprises:
rounding the current quantization parameter to an odd number to generate an odd current quantization parameter;

subtracting the odd current quantization parameter from a combined difference when the combined difference is negative, and adding the combined difference to the odd current quantization parameter when the combined difference is positive.

[c18] 18.A computer-program product comprising:
a computer-usable medium having computer-readable program code means embodied therein for decoding and AC-predicted video bit-stream, the computer-readable program code means in the computer-program product comprising:
parser means for parsing an encoded bit-stream for an AC prediction flag for a current block and for extracting a current portion of the bit-stream for the current block;
unified stage means for decoding the current portion of the bit-stream with a variable-length decoder to generate quantized discrete cosine transform (DCT) coefficients, and for inverse-quantizing the quantized DCT coefficients with a current quantization parameter for the current block to generate unified-stage output coefficients;
inverse transform means for generating pixels for the current block from selected coefficients by performing an inverse discrete cosine transform;
multiplex means, coupled to supply the selected coeffi-

cients to the inverse transform means, for selecting as the selected coefficients the unified-stage output coefficients when the AC prediction flag is false, and for selecting as selected coefficients predicted coefficients for a first row or for a first column when the AC prediction flag is true,

storage means for storing the selected coefficients for the first row and for the first column as stored coefficients and for storing the current quantization parameter as a stored quantization parameter; and

prediction means for generating the predicted coefficients for the first row or for the first column when the AC prediction flag is true by combining the unified-stage output coefficients, the current quantization parameter, a stored quantization parameter and stored coefficients for a prior block to emulate AC prediction;

whereby AC prediction is performed after inverse-quantization.

[c19] 19.The computer-program product of claim 18 wherein the prediction means further comprises:

current difference means for generating a current difference from the unified-stage output coefficients and the current quantization parameter;

prior difference means for generating a prior difference from the stored coefficients and the stored quantization

parameter;
combining means for combining the current difference and the prior difference to generate a combined difference; and
adjust means for adjusting the combined difference with the current quantization parameter to generate the predicted coefficients.

[c20] 20.The computer-program product of claim 18 wherein the current difference means further comprises:
first round means for rounding the current quantization parameter to an odd number to generate an odd current quantization parameter;
first subtract means for subtracting the odd current quantization parameter from a unified-stage coefficient that is one of the unified-stage output coefficients when the unified-stage coefficient is positive, and adding the unified-stage coefficient to the odd current quantization parameter when the unified-stage coefficient is negative;
first divide means for dividing an output of the first subtract means by two;
wherein the prior difference means further comprises:
second round means for rounding the prior quantization parameter to an odd number to generate an odd prior quantization parameter;
second subtract means for subtracting the odd prior

quantization parameter from a stored coefficient that is one of the stored coefficients when the stored coefficient is positive, and adding the stored coefficient to the odd prior quantization parameter when the stored coefficient is negative;

second divide means for dividing an output of the second subtract means by two.